

# ON SUBLUXATION OF THE HEAD OF THE RADIUS IN CHILDREN—WITH A RESUMÉ OF ONE HUNDRED CONSECUTIVE CASES.<sup>1</sup>

By WILLIAM WALDO VAN ARSDALE, M.D.,

OF NEW YORK.

INSTRUCTOR IN SURGERY IN THE NEW YORK POLYCLINIC; ATTENDING SURGEON  
AT THE EASTERN DISPENSARY.

THE lesion to which I beg to call attention is generally observed under the following conditions :

A child is brought to the physician by its mother complaining of pain at the wrist, and inability to use the arm. The child lets its arm hang motionless at its side, slightly flexed at the elbow, the hand being half-way between pronation and supination.

Upon further questioning the mother tells how she was leading the child by the hand when it stumbled or slipped, and in an effort to save it from a fall, she forcibly jerked the hand upward. At this moment she felt a click at the wrist, and the child cried out as if in pain. Although the child did not fall, yet since that time it has not used its arm or hand, and any interference with either has again called forth complaints.

On examination everything about the hand is found to be normal. The movements at the wrist are free and not painful, adduction and abduction, flexion and extension can be made passively without resistance.

Examination of the elbow-joint reveals no deformity whatever ; the olecranon, the condyles of the humerus, are all in place, and so is the head of the radius. At this point of the examination, however, the first abnormal symptom is discovered ; pressure, even if slight, upon the head of the radius is painful. Flexion of the fore-arm upon the upper arm is now

<sup>1</sup>Read before the Surgical Section of the New York Academy of Medicine.

attempted, and is freely permitted to an angle of about  $60^{\circ}$  when the movement causes pain and is actively resisted by the child. Complete extension to the straight line is also painful; but any flexion ranging between  $130^{\circ}$  and  $60^{\circ}$  may be given the arm without resistance, and is generally retained by the child. The child never supports the hand with the other uninjured one, however, as in cases of injury to the shoulder.

If pronation and supination be now attempted while the arm is held flexed at right angles (apparently the easiest position for the child) the child immediately evinces symptoms of pains. Complete pronation is possible, but is somewhat resisted by the child. Supination, however, at once calls forth energetic protestations; the child cries out and actively resists the motion as much as it can, interferes with the other hand, and endeavors to escape. There also appears to be some mechanical resistance to supination which asserts itself as soon as the intermediate position between pronation and supination is reached. But on forcing supination still further, a distinct click is to be felt at the elbow, or more correctly at the head of the radius, after which all the movements of the arm at once become free, and apparently cause no more pain. One symptom, however, still remains; direct pressure on the head of the radius is painful as at first.

If, now, the arm is left to itself, the child lets it hang as before, and uses it little or not at all. And in two or three days the child may be brought back to the surgeon with considerable swelling, both of the elbow-joint and at the wrist, and with all the symptoms just described present, only in a much aggravated degree.

If, however, the arm is put up, the elbow flexed at right angles, the hand midway between pronation and supination, in some simple splint or bandage, the child is brought back by the mother at the end of three or four days, who says the hand must be well now, as the child uses it and complains no more.

On removing the bandage the arm generally appears normal, and passive and active movements are entirely free.

This is the clinical picture for which I have used the term subluxation of the head of the radius in the title of this pa-

per, but which has been described by various writers under different designations, such as partial dislocation of the head of the radius, dislocation of the radius downward by elongation, Goyrand's injury, and others.

These are very formidable titles for an injury which can be so easily rectified, and cured in so brief a time. And it should be here stated that the injury in question is not a dislocation, as that term is usually accepted; there is no extensive rupturing of ligaments, nor have the articulating surfaces of the bones been laterally forced out of their normal position to any great extent.

The injury is comparatively slight. But, notwithstanding, it always occurs in the same typical manner, which should entitle it to acknowledgment as a separate and distinct injury. And in point of fact the lesion has been so recognized by a long line of observers—a fact which never would have occurred if the injury did not possess sufficient individuality to enable it to be recognized by others from simple description.

Now it is a curious fact, that although this injury has been often observed and frequently made the subject of careful inquiries, its nature is not perfectly understood, nor is the injury itself sufficiently widely known to prevent its often escaping detection. At any rate all authorities are certainly not agreed as to its nature; and it is this air of mystery which envelops the lesion, that lends to it a special interest. All of these reasons have prompted me to bring the subject before you to-night for discussion.

A cursory glance at the literature informs us that there have been about seventy articles written on our subject, mostly in periodical literature. The text-books, if we except the more recent ones, contain little or nothing about it. Histories of the subject are given by Malgaigne and Streubel, and others since then. Hippocrates and Celsus referred to the matter. The first who described it accurately, however, was Fournier in 1671. But after his publication it was again forgotten, till, in 1751, Duverney again described it. Subsequently it became a favorite subject among French authors.

In Germany Streubel was the first to give the subject special attention, writing his first article in 1850.

By that time it had already been described in Italy by Monteggia (1814), and in England by Collier (1836) and Gardner (1837).

In our own country it was first brought forward by Batchelder in 1856, and Hodges in 1862, and subsequently treated of by Cushing, Moore, Van Santvoord and others; while the special attention given to it by Hamilton and Stimson in their textbooks has rendered the subject a familiar one to most surgeons.

I propose, before introducing my own cases, to give a brief epitome of what we learn from the literature.

Reference is made to some 400 cases in all (at a generous estimate). Yet many consider the injury a rare one. Goyrand who alone saw half this number (200 in 30 years), says it is very frequent. The general opinion is, that while the injury is rare among surgical cases in children, it is comparatively frequent among injuries to the elbow. According to Hoffmann the proportion is about 1 in 230 patients (children). This is probably the usual frequency for dispensaries.

As a predisposing cause we find a "lymphatic" or "strumous" constitution frequently mentioned by those writers who give it attention. An atonic or relaxed state of the ligaments is a favorite theory with most writers on the subject (Sylvester, Martin, LeLyon, Denucé). Bourgnnet, however, states that the children are exceptionally healthy and sound, and show no traces of constitutional tendencies.

As to the exciting cause of the injury, there is an overwhelming testimony in evidence of traction on the hand or forearm—so much so that this point has always been considered of the first importance in diagnosis. Whether the traction is exercised by the nurse when walking hand in hand with the child, by lifting it over an obstacle or over the gutter, or by trying to sustain it when it is about to fall, or by swinging it around by both arms in play, is comparatively of less importance. In every case the weight of the child, or part of the weight, is sustained by the arm. In some cases the distension of the arm in thrusting it through the sleeve of a jacket is cited as a cause.

The question of forced pronation of the hand simultaneously

with extension has been much discussed. Bottentnit, Bourgnnet, Malgaigne, Goyrand, von Pitha, Streubel, Hoffmann, Hoffa, all insist that pronation during extension causes the injury. Allowance should, however, be made for the fact that most of the authors wrote at a time when dislocations of the radius were believed to be possible from forced pronation alone. Later writers attribute the injury more to extension with forced adduction in the elbow. Supination is also represented as causing the injury by Danyan, Rendu and Hutchinson, while a fall is given as a cause by Bardenheuer, Duverney, Lindemann and Peterson.

The greatest harmony prevails in the symptomatology of the injury. With few exceptions, the authors describe the hand as being more or less pronated, the arm hanging motionless by the side with the elbow slightly bent. A few cases where supination obtained, instead of pronation, are mentioned as exceptional. Some writers lay especial stress on the opposition to supination encountered in active as well as in passive rotary movements.

The click heard on attempting supination for the first time after the injury is denied by none. Most all writers have noticed it and do not fail to attribute great significance to it.<sup>1</sup> Only Streubel, in his second essay (1861), and Bardenheuer, in his latest works, attach no importance to it, saying crepitation in joints is something so common that it hardly deserves mention.

It is impossible to escape the impression that this click or snap so distinctly heard on supinating the fore-arm soon after the injury has been the main cause of all the mystery connected with the lesion. For to it alone is due the diagnosis of luxation or subluxation, so frequently made in these cases. The analogy with the snap heard in other joints during reduction of a dislocation appears unquestionable, and the freer motion after the snap has been heard renders the similarity still greater.

There is one point, however, which fails to complete the

<sup>1</sup>In a case reported by Perrin, as soon as the snap was felt on reduction, the child cried out: "Mother, I am cured."

analogy between the injury under discussion and other dislocations. The head of the radius can be distinctly felt in its proper place, or, at least, *very near* its proper place. And as no unchallenged cases happen to have died with the dislocation (if such it be) unreplaced, the anatomy of the lesion could never be entirely made out. In consequence room was left for the widest speculation; and the theories advanced to substantiate the diagnosis of the various authors form the principal attraction in the publications. Almost all the tissues coming into contact with the radius have, one after another, been made the subject of special theories, not excluding the muscles and the nerves.

1. Many writers, among them Dugès, James, Lindemann, Monteggia, Snedden, Holmes, Hodges and Hamilton, believe that the lesion consists in a slight anterior displacement of the head of the radius in front of the radial eminence of the humerus, an incomplete luxation of the capitulum radii. The edge of the radial cup is imagined resting against the eminence which should receive the cup. Notwithstanding, the radial head is not imagined as entirely leaving the ulnar notch, for if it had done so the displacement could not escape notice on palpation. Nor are the ligaments said to be torn, but only stretched sufficiently to allow of subluxation within the capsule. If, now, supination is made, the radial cap again slips over the eminence and a corresponding click is heard. The question as to what holds the head of the radius in its abnormal position during the persistence of subluxation is answered by some writers by saying that the elastic contraction or tonus of the muscles uniting the fore-arm with the upper arm maintain the position.

The difficulty encountered here is to reproduce the subluxation in a post-mortem specimen, which should show as little deformity as we find in the actual lesion. If the radial cup is brought forward sufficiently for its edge to rest against the eminence, the head of the radius must be displaced out of the ulnar notch; and if this is done the deformity is so apparent that it is easy of detection, and could not possibly have remained unappreciated for nearly two centuries.

The same objection holds good against the theories of par-

tial dislocation of the head backward. Martin and Boyer were advocates of this theory, and Malgaigne, Poincot and others admitted both the anterior and posterior types of the displacement.

Goyrand who at the time of writing his first paper (1837) believed in an anterior partial displacement of the head of the radius, imputed it to the action of the biceps as did also Lindemann. It is true that the biceps attaches to a point (the radial tuberosity) which might easily so displace the capitulum radii, provided the elbow were a little flexed; and we may also imagine that at the moment a child were lifted by the hand, it would forcibly contract its biceps. But I have convinced myself by experiment upon the cadaver of a child that the biceps alone is not strong enough to displace the head of the radius. Even when the *lacertus fibrosus* has been removed the muscle tears, before the least injury is done to the joint, or any subluxation is achieved.

3. A curious theory was put forward by Gardner (1837) and Rendu (1841). In extreme pronation the tuberosity of the radius was thought to slip below the internal edge of the ulna, and by becoming locked there, to make supination impossible.

4. Bourgnnet, later on, varied this theory by supposing that the locking was brought about more completely by the interposition of soft parts (*innoc. supinator brevis*, etc.), between the radius and ulna at a point, which prevented the return of the tuberosity.

Goyrand and Streubel carefully refuted these theories by showing that there was too large a space between the bones of the forearm in children for them to become interlocked. Moreover it is impossible for tissues to get wedged in between the two bones, unless there is extensive laceration—which, from the nature of injury under consideration, must be excluded.

5. Goyrand's latest theory was the partial dislocation of the triangular cartilage backwards at the wrist, in order to explain what he formerly supposed to be subluxation of the head of the radius. The wrist symptoms play so important a part in the clinical aspect of the cases that it is not surprising that the lesion should be looked for at this point.

Goyrand succeeded in getting a partial dislocation of the triangular cartilage on the cadaver by forced pronation, but the cartilage did not retain its abnormal position when the force was relaxed.

In spite of Goyrand's close study of the subject and the fact that he has observed the greatest number of cases on record,—which lends the greatest authority to his opinion, his theory has not been accepted by subsequent writers; principally from the reason, I believe, that a luxation, partial or otherwise, could not be made out clinically, at the wrist.

6. Hofmokl of Vienna has viewed the subject in a somewhat different manner. He thus describes his cases:

"The lesion occurs generally by suddenly pulling the child upwards by the hand, when it was about to fall, the hand itself being frequently not rotated at all. (In other cases a fall may account for the injury). The child lets the arm hang down as if paralyzed, complains of pain in the wrist and experiences pain on attempting to lift, or bend, or extend the forearm. The posture assumed is pronation, and slight flexion. There is very slight or no swelling at all over the radio-brachial joint; but immediately after injury (but only for a limited time) crepitation can be felt on supinating the forearm. This crepitation can be reproduced by repeated supination, after first again making forced pronation, and the head of the radius appears not to take part in the motion. After supination no pain is felt. But if no supination is practiced, pain at the wrist asserts itself."

This description tallies exactly with the one given by experienced observers of the injury under discussion. In these cases Hofmokl diagnosticates fracture of the capitulum radii inside the capsule; and he has observed on the cadaver that such a fracture can be easily produced by attaching a weight of two pounds to the radial tuberosity and letting it fall a few feet. As the biceps-muscle in a child of 2 years will well bear a strain of ten pounds without rupturing (according to my own experiments), this theory appears to me worthy of consideration.

7. Chassaignac has described a number of very similar cases under the title of painful paralysis in young children, whose

age is given as from 2 to 4 years. The cause is some traction, more or less forcible, made on the hand or forearm, and its appearance is always sudden. No surgical lesion is found on examination, but frequently soft crepitation in the joints. There is a paresis of the muscles accompanied with pain, which prevents free motion. The arm hangs in pronation, with slight flexion at the elbow. Recovery takes place spontaneously after four or five days, more frequently in forty-eight hours. The author accounts for the lesion by assuming an injury to the nerves.

The similarity of the description to that given above is so striking that we are justified in including the cases in this paper. Especially as Hamilton too hinted that a nervous lesion might account for the symptoms of the injury.

I have left till the last a theory which has been steadily gaining in favor since it was first substantiated by Streubel. Its originator was Fournier; and Duverney more accurately described it. According to this author, on extension being made by the hand, the head of the radius moves downward in the orbicular ligament, so that a diastasis occurs between the cup of the capitulum and the eminence of the humerus. There is no lateral displacement of the radial head, nor is there any laceration of ligaments. This is what has been called displacement by "elongation."

The obvious objection to this theory is that there is no apparent reason why the injury should persist. On relaxation of the extending force the head could be expected to slip back again into its normal place.

This difficulty was overcome by Perrin who believed the head of the radius to be pulled out so far that its margin caught against the lower border of the ulnar notch. This theory is hardly tenable in view of the anatomical facts.

I believe Streubel (1850) was the first to advance his most successful theory, that the return of the head of the radius so well within the orbicular ligament was prevented by the folding in of the sides of the capsule between the radial head and the eminentia cepitata.

He based his views on cadaver experiments of which he performed a number. Dissecting off the skin and the muscles

from the capsule of the humero-radial articulation, he could easily demonstrate that when the head of the radius was pulled partly out of the capsule and extreme pronation was added at the same time, the anterior part of the capsule was forced into the articular cavity by atmospheric pressure and could be held thus folded in, by quickly returning the radial head. If, now, supination were performed, the fold would disengage itself with a click. A similar mechanism occurred with the posterior portion of the capsule on extreme supination.

These experiments have been repeated in this country by Moore and by Van Santvoord, the latter of whom published the results of cadaver experiments on seventeen infants.

Nothing can be more simple than to produce the dipping-in of the capsule into the joint cavity above the radial head, when the skin and the muscles (supinator longus and extensor carpi radialis longior) have been removed over the joint. But when these are left intact, it is a much more difficult matter.

Van Santvoord did succeed in producing the folding of the capsule into the joint five times without removing the skin,—but it should be remembered that this was in the cadaver, and where the muscles have not the tonus they have during life.

When children forcibly pull on their fingers one can frequently see how the atmospheric pressure forces in the integument into the carpo-phalangeal articulation. But it is not easy to comprehend how such a deformity should persist even if we make allowance for the fact that the edge of the radial head presents a more defined margin than does a phalanx of the hand—especially when we observe on dissection that the capsule is adherent to the tissues overlying it.

The snap, too, heard in these cadaver-experiments is of a different character from that felt during examination of the injured children. It is of a softer quality, and the resistance to supination is not so well marked.

If the degree of the interposition of the capsule between the radial head and the eminence be still further exaggerated, we encounter another theory: that of the partial slipping-up of the lower margin of the orbicular ligament over the rim of the radial head. In this case the radial head is at the point of emerging from the annular ligament altogether. This is only

possible when the capsule has been partly torn. This theory was advanced as an explanation for the lesion under consideration by Duverney, Pingaud and Hutchinson. Stimson also accepts this theory as the most probable from a clinical point of view and the best in keeping with the literature of the subject.

Finally there are a number of writers who treat the whole matter with skepticism. Streubel himself, who had originated the theory of capsular interposition, abandoned it in his later essay (1861) and believed that all the so-called sublaxations of the head of the radius in children were simply an ill-assorted and badly diagnosticated lot of bruises, sprains and stretchings of the ligaments, and Koenig, Bardenheuer and other recent writers follow in his footsteps.

Any one, I believe, who has seen a fair number of the cases in question will admit that they represent a perfectly unique and characteristic injury, always occurring in the same typical manner, and easily to be differentiated, on the one hand from atypical sprains and bruises, and on the other, from true, palpable dislocations.

As to the treatment nearly all the writers are agreed as to the manner of reduction. Extension of the forearm while in a semi-flexed position, combined with supination, with or without direct local pressure on the head of the radius, are the directions generally given. To this some add sudden flexion of the elbow.

In regard to the after-treatment, opinion is divided: some maintaining that none is necessary, others advising the use of a sling or a splint for several days, Malgaigne for two weeks, and Hofmokl for four weeks. The treatment by splints is generally advised in order to avoid recurrence of the displacement, which is admitted by many to be frequent.

The prognosis is generally given as excellent—the injury rectifying itself in a short time, if left unreduced. The more careful observers allow that tumefaction may follow. Cushing says it may give rise to serious trouble and to chronic arthritis; Lindemann to permanent enlargement of the elbow; and partial ankylosis is mentioned by Spear.

As may be expected of so slight a lesion, there are scarcely

any records of post-mortem examinations in these cases.

Fifield mentions two in children: in one the head of the radius was found dislocated and resting on the outer condyle, in another a portion of the capitulum of the radius was found broken. This latter appears to me to be of some interest; while the former may be ruled out, I think, as representing a true dislocation.

Dugès had one autopsy, but the result is not given. Malgaigne gives one, but this was in the adult and was also a case of complete dislocation, for the head of the radius was in front of the ulnar notch.

Loebker of Vienna operated upon five cases for trouble ensuing after injuries to the elbow in childhood, and found longitudinal fractures in two cases (through the radial head), complete luxations in the others.

Sprengel gives a case where the head of the radius was found outside the capsule in a boy six years of age after a fall. But we have no evidence that these cases were analogous to the ones under consideration.

We have, therefore, to fall back upon cadaver-experiments. And here those by Schüller appear deserving of mention, for the reason that he experimented most conscientiously upon some hundred cadavers. German surgeons ascribe to him the discovery that simple forced pronation cannot produce dislocation forwards of the radial head, and the most recent writers on our subject have not insisted that the injury under discussion was caused by pronation. He did show, however, that forced adduction at the elbow, where there is normally no adduction, frequently caused displacement of the radial head; and could even be the cause of the head slipping out of the orbicular ligament. But this was only in a few cases; in the greater number of cases forced adduction produced some epiphyseal injury to the lower end of the humerus. Moreover in order to draw the end of the radius out of the orbicular ligament, he had to support the upper end of the ulna, at the elbow joint with one hand.

Stimson was the first to advance the explanation that simple forced extension by overcoming the normal inclination of the

fore-arm outward from the elbow in children, would act as adduction.

I now turn to the cases that have come under my personal observation, of which there are one hundred. These were all treated at the Eastern Dispensary of New York City. There are nearly one hundred and thirty cases on my books. Some of these were seen during my absence by my colleagues, and have been excluded. Three cases occurred in adults, and have also been excluded. Then some cases were not well marked, so that the diagnosis rested between contusions and other injuries of the elbow joint in children, and the one under consideration. These have been likewise excluded.

The remaining number one hundred.

I believe it is essential to exclude all doubtful cases, as well as all cases occurring in adults, in order to obtain as clear a clinical picture as possible.

As to the frequency of the injury: these cases belong to a material of over ten thousand purely surgical cases seen by me in less than two years. But as many cases were sent to me for treatment from the childrens' class by the courtesy of my friend Dr. Koplik, I may say that the cases represented a material of over 33,000 patients.

The frequency, then, of our injury is one per cent. for purely surgical cases of all ages, and about one-half per cent. for children (with all ailments, but under ten years of age.)

These figures correspond with those of Hoffmann quoted above.

The average age of the children was two years and a quarter, the oldest one being nine years and the youngest only two months of age. Most authorities give the age as under six.

As regards the habit and constitution of the little patients, many were badly nourished pale and sickly children, while a great number were of robust and healthy appearance.

In some of the cases undoubted signs of rhachitis were present, to which my attention was first called by Dr. Koplik; and I regret not having commenced to notice this symptom at an earlier date, so as to enable me to make a more concise statement on this point. A tubercular constitution was not a general concomitant of the injury, as many authors have stated.

The exciting cause was generally some violent traction on the hand or fore-arm; but I could not ascertain that the hand was in pronation at the time in any one case. In about one-third of all the cases a fall was said to be the cause of the injury. But on closer inquiry I generally found that the mothers retracted this statement, when confronted with the statement that they must have lifted the child, or else they stated they had left the child under the care of others for a time, and that these had reported a fall on their return. In two cases the child sustained a fall and was picked up by one hand, the injury being attributed to the fall, instead of to the lifting. I therefor hesitate to place much reliance in the statements that a fall generally produces the injury. Quite frequently something was felt to snap or give way at the time of lifting; but this snap was generally localized at the wrist.

The symptoms were invariably the same: pronation, more or less complete, and but slight flexion at the elbow. No case was observed in supination. There was certainly no displacement to be made out at the point of the radial head. The fore-finger and thumb could be placed on either side of the head with facility in most cases, and no lateral displacement existed. Nor could any displacement downwards be detected. When reduction was made, however, with one thumb over the radial head, at the moment when the hand entered the position of supination, and the characteristic snap was felt, the jar communicated to the head of the radius was distinctly to be appreciated as a lateral one,—not as one in the longitudinal axis of the bone.

The other symptoms were those that have been described above.

In but few of the cases the click could not be felt,—in a number of others, however, the click could be repeated twice or even three times (in one case), by again executing forced pronation. In some cases the click could be more accurately described as a crunching crepitus.

The after-treatment usually consisted in the application of a simple paste-board box splint; sometimes a rectangular splint or a well-sized dextrine bandage was used; and the patients directed to keep the hand in a sling. The splint was left on

for three days, at the end of which the child was generally found cured. In the first cases where no splints were used, relapses were frequent. In about five cases, the splint had to be kept on for six days, swelling having ensued at the elbow or at the wrist, or, more generally, both. But whether or not these cases were the same in which no click was felt on attempted reduction, my notes do not say.

No case of serious trouble resulted from any of these injuries; although if left unreduced, I am not prepared to say what results might possibly ensue.

The diagnosis rests mainly upon the 'click' and the free motion after reduction, together with the pain on pressure over the radial head. Differential diagnosis lies between contusion and other sprains of the elbow and the wrist.

To what anatomical conditions shall we ascribe the injury?

Of the thirteen theories mentioned above, three appear especially deserving of notice.

First. The partial anterior displacement of the head of the radius, which cannot be wholly excluded, although exact palpitation should reveal the displacement, and although we can find no satisfactory cause for its persistence. This theory would be better supported if it could be shown, that the injury occurred mainly in children affected with rhachitis. For we know that in this disease the ligaments are relaxed and are easily stretched. We should however be cautious in admitting the ligaments to be relaxed in one joint, unless there was evidence of the existence of flail-joints in other parts of the body.

Second. The theory of interposition of the orbicular ligament between the radial head and the humerus. It does not appear to me to be so easy to produce the simple folding-in of the membranes above the radial head in the living subject, where they are united with the muscles, and are distended by the muscular tonus, and where the synovial lining is very slippery, as it is in the cadaver. The partial emerging of the head of the radius below the orbicular ligament could be possible only if the capsular ligament were torn.

In this case we should expect some ecchymosis and hæmorrhage, which, however, has never once been observed.

The third theory deserving consideration is that of some

local injury done to the head of the radius within the capsule of the joint. This theory is best substantiated by post-mortem evidence and by operations. It is vague in so far as no typical lesion of this sort has been experimentally established, except the fracture of the head. We might, however, expect partial solutions of the epiphysis at the head of the radius, when we consider that most of the children affected are under four years of age. This latter theory was advanced as early as 1839 in an editorial in the *Medico-Chirurgical Review*. And all observations on record can be easily made to harmonize with it. The lateral jerk of the biceps when the child catches at the nurses hand to save itself from falling, exerts a sudden traction on the radius, so that the epiphysis may be partly torn off and pushed to one side. After replacement the head of the radius is held in position by the muscular tonus, which causes the capitellum of the humerus to press down upon it; there is no tendency to displacement, unless the accident is repeated, which accounts for the rapid recovery after a few days on the one hand, and the frequency of recurrence during the first few days on the other hand. The absence of any appreciable displacement of the head of the radius out of the ulnar notch harmonizes (by means of this theory) with the assertions of Malgaigne and other surgeons; who state they have felt slight displacements of the radius from its normal position. The theory further accounts for the uselessness of the arm, while the displacement remains unreduced: the pain produces reflex inhibition of motions; but a greater pain, as a pinch, induces the child to move the arm. The swelling which obtains at the elbow when the injury remains unreduced is accounted for, while absence of hæmorrhage or ecchymosis is explained by the capsules remaining intact. The mechanical resistance to supination may be explained by the excentric configuration of the head of the radius: the epiphysis pushed partly to one side, impinges upon the ulna, until forced supination overcomes the resistance, and reduction is accomplished at the same time. The facts that simple pressure upon the head of the radius, without extension or supination will not reduce the dislocation,—that simple traction will not reduce it, and that it frequently becomes reduced spontaneously are accounted for.

Finally the objections made to the theory of capsular inter-

position above the head of the radius by Bourgnnet and Perrin, that there is no lowering of the radial cup below the level of the capitellum of the humerus, and the statements of Marjolin that he found slight deformity at the elbow, and of Bardenheuer, that supination and rotation do sometimes not rectify the injury, are all in accordance with this theory. And so are also those statements that sometimes the hand is retained in supination.

However well this theory may accord with the descriptions, on paper—I have not satisfied myself clinically or anatomically of its truth. I could not produce any typical injury to the head of the radius as Hofmohl describes, by attaching a weight of two pounds to the neck of the radius and letting it fall. And I cannot conceive how a partial rupture of the radial epiphysis should be prevented from becoming complete, in which case there should in my opinion be more deformity present.

I am therefore not prepared, before further study of the subject, to decide in favor of any one of the numerous theories advanced to explain the lesion under consideration.

#### CONCLUSIONS.

1. The injury frequently occurring in children and called subluxation of the head, or displacement by elongation, of the radius is a well-defined, typical injury with well-marked, constant symptoms, and due to the same anatomical lesion in each case.

2. The frequency is over one per cent. of surgical injuries in children.

3. It occurs in children under nine years of age.

4. The most frequent exciting cause is sudden traction by the hand or fore-arm; more rarely a fall.

5. The principal symptoms of the injury are: absence of appreciable deformity; loss of function of the arm; localized pain over the head of the radius on pressure; pronation of the hand; slight flexion of the elbow. Crepitation or snapping upon forced supination with restoration of function.

6. Treatment with a splint is advisable in order to prevent recurrence.

7. The anatomical lesion causing the injury is not yet satisfactorily established.

## TABLE OF CASES.

<i>Number.</i>	<i>Date, 1887.</i>	<i>Years.</i>	<i>Age. Months.</i>	<i>Sex.</i>	<i>Nationality of Parents.*</i>
1	June 22.	4	....	M.	A.
2	July 12.	4	....	F.	A.
3	August 18.	1	7	M.	G.
4	August 27.	2	6	F.	R.
5	September 10.	1	6	F.	G.
6	September 10.	2	....	M.	G.
7	September 23.	2	3	F.	U. S.
8	September 28.	1	10	M.	G.
9	October 8.	1	10	M.	R.
10	October 15.	1	5	F.	R.
11	October 17.	2	....	M.	G.
12	October 22.	1	....	F.	R.
13	November 1.	1	6	M.	R.
14	November 5.	....	9	M.	A.
15	November 9.	4	....	M.	U. S.
16	November 11.	....	11	F.	R.
17	November 14.	2	....	F.	R.
18	November 28.	....	10	F.	R.
19	December 7.	....	10	F.	R.
20	December 10.	3	....	F.	U. S.
21	December 13.	2	....	F.	R.
22	December 14.	3	....	M.	U. S.
23	December 15.	....	6	M.	R.
24	December 15.	2	9	F.	G.
25	December 27.	3	....	F.	R.

\* The children were most all born in this country, but of German, Austrian or Russian parents, to which the capitals G, A, R respectively refer.

TABLE OF CASES.—CONTINUED.

<i>Number.</i>	<i>Date, 1888.</i>	<i>Age.</i>		<i>Sex.</i>	<i>Nationality of Parents.</i>
		<i>Years.</i>	<i>Months.</i>		
26	January 1.	3	....	M.	R.
27	January 10.	2	....	F.	R.
28	January 13.	4	....	M.	R.
29	January 30.	3	....	M.	G.
30	February 11.	....	3	F.	R.
31	March 7.	2	....	F.	U. S.
32	March 13.	3	....	F.	A.
33	March 23.	....	7	F.	A.
34	March 24.	1	6	F.	R.
35	April 10.	3	....	M.	R.
36	April 12.	4	6	M.	R.
37	April 18.	1	....	F.	R.
38	April 19.	1	2	F.	R.
39	April 24.	....	7	F.	R.
40	April 30.	3	....	F.	R.
41	May 2.	1	1	F.	R.
42	May 22.	2	....	F.	A.
43	May 28.	1	5	M.	A.
44	May 31.	3	....	F.	G.
45	May 31.	3	....	F.	A.
46	June 4.	1	....	F.	R.
47	June 5.	2	....	F.	A.
48	June 5.	2	6	F.	A.
49	June 12.	1	6	M.	R.
50	June 14.	2	....	F.	R.

TABLE OF CASES.—CONTINUED.

<i>Number.</i>	<i>Date, 1888.</i>	<i>Age.</i>		<i>Sex.</i>	<i>Nationality of Parents.</i>
		<i>Years.</i>	<i>Months.</i>		
51	June 16.	2	....	F.	R.
52	June 18.	2	6	M.	U. S.
53	June 18.	....	9	F.	R.
54	June 23.	6	....	F.	R.
55	June 25.	3	....	F.	R.
56	June 27.	....	7	F.	R.
57	July 5.	8	6	M.	R.
58	July 7.	1	9	M.	R.
59	July 7.	5	....	F.	R.
60	August 25.	1	6	F.	A.
61	August 28.	1	4	F.	G.
62	August 31.	1	1	F.	R.
63	September 1.	1	1	F.	R.
64	September 3.	....	9	F.	R.
65	September 7.	1	6	F.	R.
66	September 8.	2	6	F.	A.
67	September 21.	4	....	M.	R.
68	September 22.	3	....	M.	R.
69	October 2.	5	....	F.	R.
70	October 2.	3	....	F.	R.
71	October 5.	1	6	F.	R.
72	October 7.	2	....	F.	A.
73	October 13.	3	....	M.	R.
74	October 16.	3	....	M.	U. S.
75	October 19	1	1	F.	R.

TABLE OF CASES.—CONCLUDED.

Number.	Date, 1888.	Age.		Sex.	Nationality of Parents.
		Years.	Months.		
76	October 23.	1	4	F.	A.
77	October 23.	4	....	M.	R.
78	October 30.	1	6	F.	A.
79	November 14.	4	....	F.	R.
80	November 16.	3	....	F.	A.
81	November 28.	2	....	F.	R.
82	December 10.	4	....	M.	R.
83	December 12.	3	....	F.	G.
84	December 14.	2	....	M.	R.
85	December 26. 1889.	....	2	F.	R.
86	January 3.	2	...	F.	R.
87	January 8.	2	....	M.	Egypt.
88	January 14.	3	....	F.	R.
89	January 14.	....	8	M.	R.
90	January 15.	....	7	F.	U. S.
91	January 21.	1	....	F.	R.
92	January 28.	...	9	F.	R.
93	February 3.	3	....	M.	U. S.
94	February 9.	1	10	F.	G.
95	February 10.	1	3	M.	R.
96	February 10.	1	2	M.	R.
97	February 19.	3	....	F.	R.
98	February 20.	2	....	F.	R.
99	February 23.	2	....	F.	R.
100	March 7.	4	....	F.	R.

## BIBLIOGRAPHY.

- Ashurst.* Principles and Practice of Surgery. 2, 284. Phila. 1878.
- Bardenheuer.* Die Permanente Extensionsbehandlung. Stuttgart. F. Enke, 1889.
- Bardenheuer.* Die Vorletzungen der oberen Extremität. II Thl. 88. Deutsche Chirurgie von Billroth und Lucke. 63, b.
- Batchelder.* New York Jour. Med., May, 1856, p. 333.
- Bottentuit (Bouley).* De radii superioris extremitatis dimotione in infantibus frequentiori. Paris, Thesis, 1787.
- Bourgnet.* Rev. Med. Chir. T. xv., p. 287. 1854. Mai et June.
- Boyer.* Traite des maladies chir. iv. 214.
- Chassaignac.* Paralysie douloureuse des jeunes enfants. Arch. generales de med. 1856, i., p. 653.
- Cushing, H. W.* Subluxation of the radial head in children. Boston M. and S. J., 1886. 114, 77.
- Danyan, Ant.* Arch. de med. de Paris. April, 1841.
- Denncé.* Memoire sur les luxations du coude. Paris, 1854.
- Descamps.* Etude sur la luxation incomplete de l'extremite superieure du radius. These de Paris, 1876.
- Dugès.* These de Paris.
- Dugès.* Journal hebdomadaire. 1831, tome iv, 197.
- Duverney.* Traite de maladies des os. 1751.
- Fournier.* L'oeconomie chirurgicale. 1671, 250.
- Gardner.* On an undiscribed displacement of the bones of the forearm in children. Lon. Med. Gaz., vol. xx, 878, 1837. also, Gaz. Med. de Paris, 1837, Oct. 21, 664.
- Gente.* Ueber Distensionsluxationen. Wurzburg, 1885, P. Schreiner.
- Goyrand.* Quelques mots sur une luxation incomplete de l'extremite superieure du radius commune chez les enfans en bas age. Annales de la Chir. Franc. et etrang. T. V. 1842, 129.
- Goyrand.* Sur la luxation de fibro-cartilage inter articulaire du poignet en avant de l'extremite inferieure du cubitus. Bull. du therap., Mars 30, 1860.
- Goyrand.* Luxation du fibro-cartilage interarticulaire du poignet en avant de la surface articulaire carpienne, du cubitus, leesion tees-commune chez les enfans en bas age. Bull. de la Soc. de Chir. 1861.
- Goyrand.* Gaz. med. de Paris. 1837, m. 8, 115.
- Hamilton, F. H.* A practical treatise on fractures and dislocations. Philadelphia, Lea's Son & Co. 1880.
- Hansen, A.* Om den ufuldkomne Luxation af Radius fortel. Norsk. Mag. f. Lægevidensk Christiania. 1888, 4 R. 3, 54.
- Heath, C.* Minor Surgery, 1887.
- Holmes' Surgery.* London, 1881.
- Hodges.* Boston Med. and Surg. Journ., 1862, vol. lxxii, 129.
- Hoffa, Albert.* Lehrbuch der Fracturen und Luxationen. Wurzburg. Stahel's Bh. 1888.
- Hoffmann, E.* Ueber die Subluxation des Radius—Kopfschens bei kleinen Kindern. Deutsch med. Wochnschr xii, 7, 106, 1886.
- Hofmokl.* Ueber den intracapsularen Brech des Radius kopfschens beim Kinde. Wein. med. Presse, 1879, 20, 369, 405.

- Hutchinson, J. jr.* Partial dislocation of the radius peculiar to children. Brit. M. J., 1886, i, 9.
- Hutchinson, J. jr.* On certain obscure sprains of the elbow occurring in young children. Annals of Surgery, 1885, vol. ii, 91.
- Huter.* Grundriss der Chirurgie.
- James, J. B.* Partial dislocation of the head of the radius peculiar to children. Brit. M. J., 1886, 12.
- Jousset.* Gaz. med., p. 216, 1833.
- Koenig, Franz.* Lehrbuch der speciellen Chirurgie, iii, 107, Berlin, 1881.
- Lindemann.* Dislocations of the elbow in children. Brit. Med. J., 1882, Mar. 18, 378.
- Lindemann.* Partial dislocation of the head of the radius peculiar to children. Brit. Med. J., 1885, ii, 1058.
- Loebker, R.* Ueber die Behandlung geirsser Luxationen und fracturen des capit rad. durch. Resection. Wien. med. Presse, No. 34, 35, 1883.
- Mackie.* Injury peculiar to children. Brit. M. J., Apr. 29, 1882, p. 15.
- Malgaigne.* Traite des fractures et des luxations. Paris, 1847.
- Medico-Chirurg. Review.* Editorial. 1839.
- Moore, E. M.* Subluxation of the radius from extension in young children. Jr. N. York M. Ass. (1885), 1886, vol. iii, p. 18.
- Moore, R. M.* Dislocation forwards of the head of the radius. Med. Press West. N. York, 1887, 2, 23.
- Perrin.* Journal de la Chir. de Malgaigne, vol. v, p. 145, 1849. Revue med.-chir., T. v, 146.
- Petersen, F.* Ueber die Ursache der Ellenbogen verrenkung ber Kindern und Frauen. Centralbl. J. Chir., 1886, xv, 15, 265.
- Pinel.* Memoirs sur le mecanisme de luxation de de l'avant bras. Obs. de phys. de Rosier, 1789, T. xxxv, p. 457, 1849.
- Pingand.* Dict. encyclopedique, art. coude., p. 580, 1878.
- Pitha.* Billroth, Bd. iv, p. 94.
- Poinsot, G.* Dislocation of the head of the radius downwards (by elongation), with comments by F. H. Hamilton. N. Y. Med. J., 1885, 41, 8.
- Rendu.* Gaz. med., 1841, 301.
- Schüller.* Chirurgische anatomie, 1885, Berlin.
- Snedden, D.* Injury peculiar to children, probably dislocation of either end of radius. Brit. M. J., 1882, p. 499.
- Stimson, L. A.* A treatise on dislocations. Phila., 1888.
- Sprengel.* Zur Behandlung veralteter Luxationen im Humero-Radial gelenk. Centralbl. f. Chir., xiii, 10, 153, 1886.
- Strenbel.* Ueber sammtliche in Ellbogengelenke vorkommenden Luxationen. Prager Viertelj. schrft. f. d. pract. Heilkunde, 1850, Bd. ii, 54, Bd. 25.
- Streubel.* Ueber die falsche Beurtheilung gerisser geringfügiger Verltzungen am Vorderarm kleiner kinder. Prager Viertelj. schr., Bd. 70, p. 1. 1861.
- Van Santvoord, R.* Dislocation of the head of the radius downward by elongation. N. York Med. J., 1887, 45, 63.